DETECTING OF TRACE CONTRABAND COCAINE, HEROIN AND CAFFEINE ON ALUMINUM SURFACE BY MICRO RAMAN WITH EXCITATION LIGHT 514.5 nm

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**Abstract**: Using a clean Al slice as substrate, Raman spectra of 3 samples of contraband Cocaine with different fluorescence background are obtained with excitation light 514.5 nm. Also a satisfactory Raman result from trace contraband Heroin with low concentration on Al slice is observed. With the same method Raman investigation for seized Caffeine, although strong fluorescence produced by the impurities in the sample, Raman characteristic peaks can be clearly identified. The result indicates that a clean and glazed Al slice used as the substrate will be helpful to improve the quality of Raman spectra of contraband narcotics.

When using visible light as excitation source to contraband narcotics, fluorescence becomes the serious problem, which can mask Raman lines in Raman spectroscopy. To change the excitation wavelength or pretreat the sample can suppress the fluorescence, but has some limitations in practical application of Raman spectroscopy in narcotics, such as relatively low efficiency of Raman intensity with low excitation wavelength or thermal effect to saturated samples. Delighted by SERS effect, we use a clean and glazed Al slice as substrate and expect to obtain Raman spectra from trace narcotic with relatively low fluorescence. According to the SERS image field model [1], the dipole moment induced in the molecule by the incidence field and its image field is

\[
\mu = \alpha (1 - \frac{\alpha}{4\pi^2} \frac{\varepsilon - \varepsilon_0}{\varepsilon + \varepsilon_0} )^{-1} E
\]

where \( r \) is the distance between the molecule and surface of Al. A decidedly real surface enhancement, which occurs at flat metal surface, is due to the fact that the molecule near the metal

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**Fig.1.** Raman spectra of trace contraband Cocaine on Al slice
surfaces would be provided to an enhancement of 16 in its Raman scattering.

3 powder samples of seized Cocaine numbered 1 to 3 with different color. No.1 and No.2 are white and No.3 is soil-yellow. A trace sample is obtained by depositing a little quantity of Cocaine on a clean Al slice. Raman results of 3 samples are recorded by using a Renishaw micro Raman system 1000 with excitation 514.5 nm. Raman results displayed in fig. 1 show that very little fluorescence is observed in sample No.1 and No.2 and strong fluorescence in No.3, which is obvious that it comes from impurities in seized Cocaine. Raman peaks 998 cm\(^{-1}\), 1596 cm\(^{-1}\), 1713 cm\(^{-1}\), 3067 cm\(^{-1}\), belong to breathing and stretching vibration of Benzene ring, stretching vibration of C•O in the substituted group and C-H in Benzene, these spectral lines can be used to identify Cocaine from other narcotics [2].

Contraband Heroin with low concentration and soil-color is used for Raman investigation. Firstly one person, with cleanly middle finger is invited to touch the Heroin sample, and continuously presses with the same finger on different spots in a cleaned Al slice to form 50 fingerprints. Focusing laser spot in the area of the fiftieth finger-print on the Al slice, Raman result is recorded and displayed in fig.2, which is as the same as pure Heroin. Changing the measurement point in different parts of the fiftieth finger-print, the same result can be obtained congruously. Also A Raman measurement is made directly from bulk illegal Heroin and more strong fluorescence background is observed. According to Image Field model, glazed Al surface provides a Raman enhancement factor 16 and in the meantime decreases fluorescence in Raman scattering process.

![Fig.2. Raman spectra of trace contraband Heroin and Caffeine on Al slice](image)

Seized Caffeine with solid shape and soil-color is investigated with the same method as described in Cocaine. Raman spectrum is as same as neat Caffeine [2], but with strong fluorescence background. Comparing the result with pure one [2], it is obvious that the seized Caffeine is low concentration and fluorescence in the spectrum comes from other chemical elements in the sample.

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